(12) UK Patent Application (19) GB (11) 2 324 491 (13) A

(43) Date of A Publication 28.10.1998

(21) Application No 9807916.3

(22) Date of Filing 14.04.1998

(30) Priority Data
(31) 19716976 (32) 23.04.1997 (33) DE

(51) INT CL[6]
B25D 16/00

(52) UK CL (Edition P)
B4C C1A1 C1C C1F C9X

(56) Documents Cited
GB 2121717 A EP 0608083 A1 US 4418766 A

(58) Field of Search
UK CL (Edition P) B4C
INT CL[6] B23B 45/00 45/02 45/16, B25D 11/00 16/00

(71) Applicant(s)
Robert Bosch GmbH
(Incorporated in the Federal Republic of Germany)
Wernerstrasse 1, Stuttgart-Feuerbach, D-70442
Stuttgart 30, Federal Republic of Germany

(72) Inventor(s)
Helmut Wanek
Markus Heckmann

(74) Agent and/or Address for Service
A A Thornton & Co
Northumberland House, 303-306 High Holborn,
LONDON, WC1V 7LE, United Kingdom

(54) Abstract Title
Hammer drill with clutch mechanism

(57) An electric hammer drill has two gear trains for operating the device in two different modes and has a changeover device, for switching between the modes, comprising a clutch 34. The clutch comprises a first gear 16 axially slidable and rotatable about a countershaft 28 and driven by a drive shaft 13 of an electric motor. A second gear 37 is rotatably and axially fixed to countershaft 28 and has external teeth 37 which can mesh with internal annular teeth 36 on the first gear. The first gear is axially movable into engagement with the second gear by means of an operating slide 38 that is moved by camming action via a rotatable changeover knob 41 whose axis is parallel to that of the counter shaft.

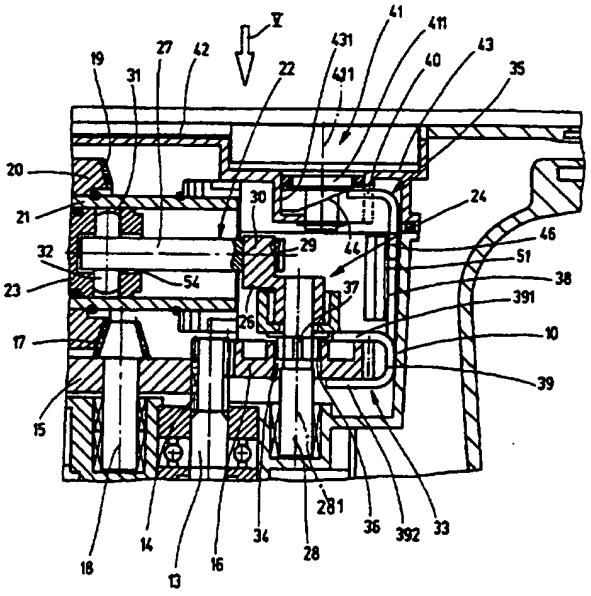

Fig.2

GB 2 324 491 A

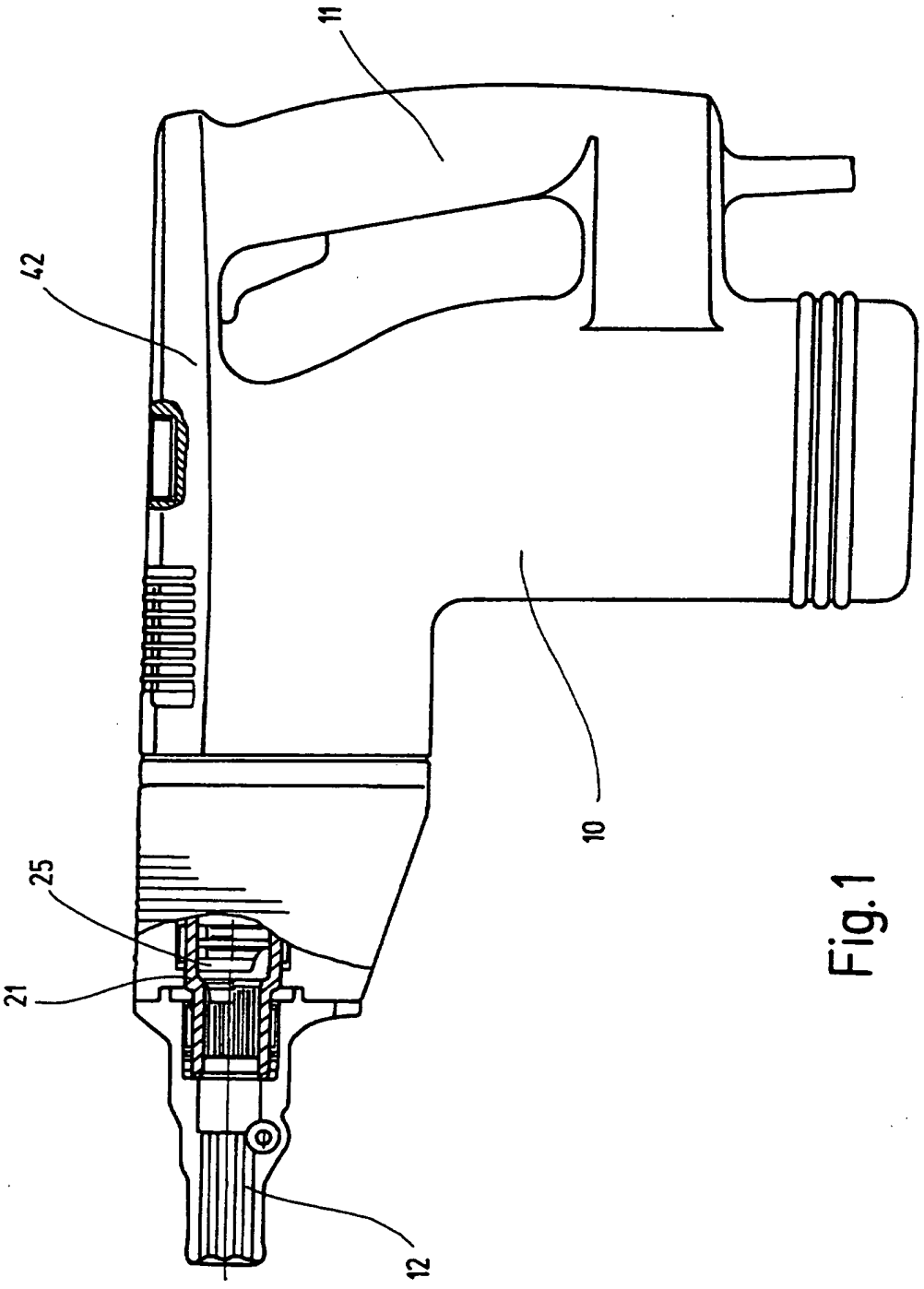

Fig.1

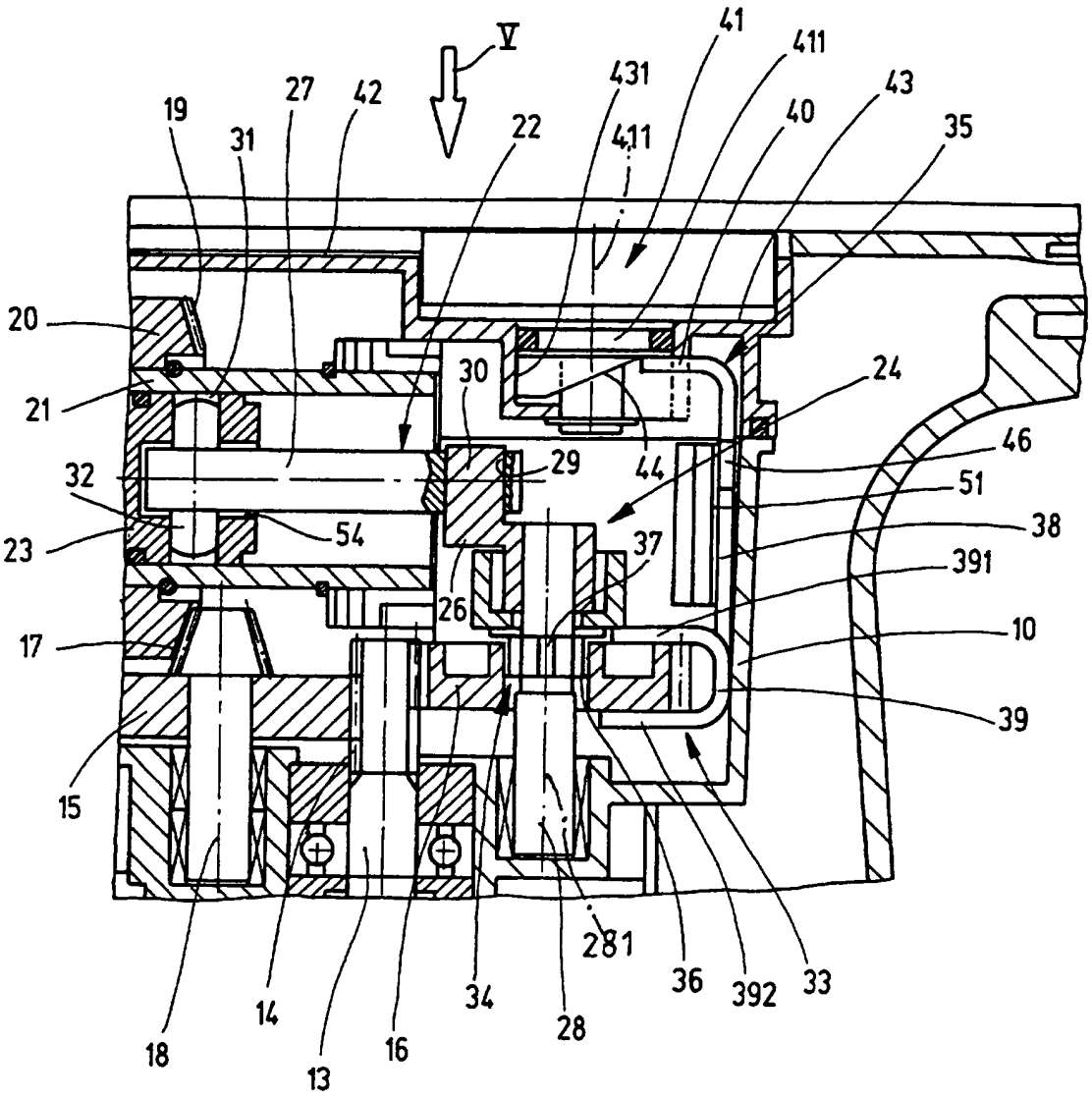
V
41
411
431
43
40
35
19
31
27
42
22
411
20
21
30
24
46
32
29
44
51
54
38
23
37
391
26
17
10
39
15
281
36
392
33
34
14
28
18
16
13

Fig. 2

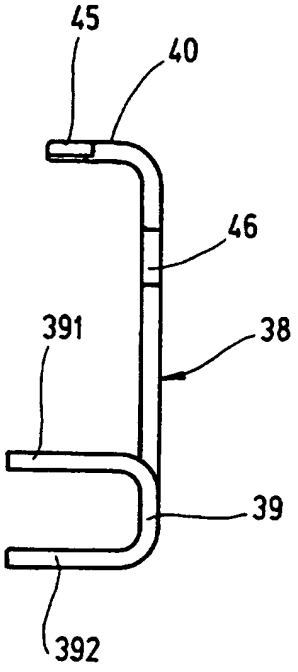

Fig. 3

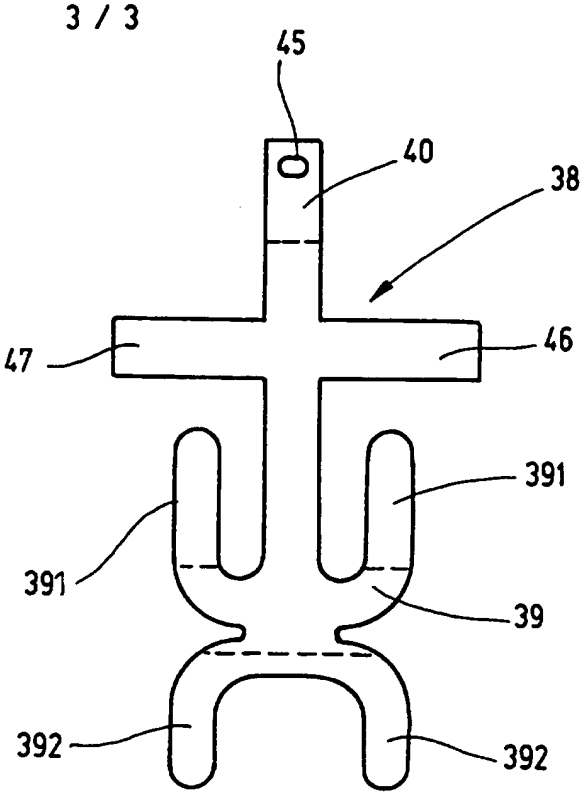

Fig. 4

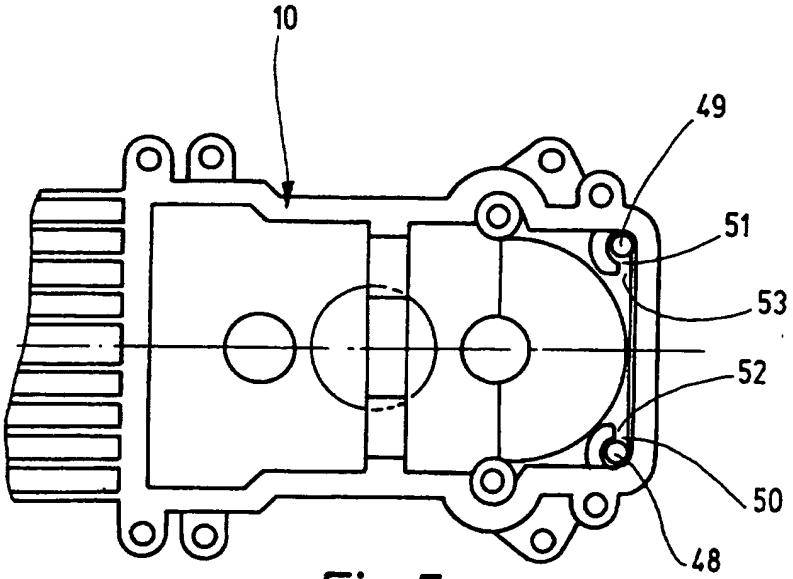

Fig. 5

Electric tool machine

Background art

The invention relates to an electric tool machine for rotary and/or impact tools, in particular a hammer drill or impact drilling machine, of the type defined in the preamble of claim 1.

In a known electric tool machine in the form of a hammer drill (DE 43 02 083 A1), of the two clutch parts, disposed on the countershaft, of the clutch in the changeover device for switching between "hammering" and "combined drilling and hammering" modes, the one clutch part is seated in a freely rotating and axially non-displaceable manner and the other clutch part is seated in a non-rotatable but axially displaceable manner on the countershaft. The first clutch part meshes with a ring gear in a pinion of a coupling shaft driven by the output shaft of the electric motor and the second clutch part is displaceable on the coupling shaft by means of a manually operable changeover switch supported on the housing so that, in the one displacement position, the clutch parts engage non-rotatably one into the other and so the engaged clutch connects the first clutch part driven via its ring gear in a non-rotatable manner to the countershaft and, in the other displacement position, the clutch parts are disengaged from one another and so the disengaged clutch enables free rotation of the driven first clutch part on the countershaft. For displacement of the second clutch part, the latter has a peripheral groove, into which an eccentric pin projecting axially from the changeover switch engages. When the changeover switch is rotated, the eccentric pin travels through a semicircular arc and displaces the second clutch part axially by a distance corresponding to the diameter of the semicircular arc. The non-rotatable engagement of the two clutch parts one into the other is effected by means of rolling bodies, which lie in radial through-bores of the second clutch part, are held by means of an enclosing spring washer and may be inserted into

detent recesses disposed in the first clutch part. When the clutch is engaged, the hammer drill operates in combined drilling and hammering mode, and the rolling bodies with spring washer perform the additional function of an overload protection device which, in the event of seizing of the hammering tool, interrupts the rotary connection to the electric motor.

Advantages of the invention

The electric tool machine according to the invention having the characterizing features of claim 1 has the advantage of a constructionally very simple design and extremely easy assembly of the mode changeover device. The operating slide of the changeover device, which slide is longitudinally displaceable by means of a rotatable changeover knob, moves upon operation parallel to the shaft carrying the clutch so that, upon displacement of the one clutch part on the shaft for engagement and disengagement of the clutch, no deflection of the direction of force occurs and low displacement forces are sufficient for engagement and disengagement of the clutch. The changeover device according to the invention therefore operates smoothly and is extremely user-friendly. The changeover is "synchronized", i.e. it is possible to change over not only when the electric tool machine is stationary but also when the electric tool machine is in operation.

Advantageous developments and improvements of the electric tool machine indicated in claim 1 are possible by virtue of the measures outlined in the further claims.

According to a preferred embodiment of the invention, the displaceable clutch part is formed by a driving wheel, which is constantly meshed with the output shaft of the electric motor and seated in a freely rotating and axially displaceable manner on the shaft. By means of an internal gearing of the driving wheel which cooperates with a corresponding external gearing on the

shaft, the clutch, the other clutch part of which is formed by the shaft, is engageable by displacing the driving wheel. This has the advantage that the driving wheel, which is needed for introducing the power flux from the output shaft of the electric motor into the gear train, in the gear train simultaneously forms the operable clutch part, thereby reducing the number of structural parts.

According to an advantageous embodiment of the invention, the changeover knob of the changeover device, which changeover knob is rotatable about an axis parallel to the countershaft, has at its underside a ramp-like control cam extending in direction of rotation, and the operating slide rests with a control lug under spring action against the control cam and engages with an operating fork over the driving wheel displaceable on the shaft.

In an advantageous manner, according to a further embodiment of the invention, the operating slide is manufactured as a sheet-metal punching, and both the control lug and also an operating fork of the operating slide which engages over the two end faces of the driving wheel are bent out from the sheet-metal blank. Said construction of the changeover element, which is very inexpensive from a production engineering viewpoint, helps to achieve a further reduction in costs.

Drawings

The invention is described in detail below with reference to an embodiment which is illustrated in the drawings. The drawings show:

Fig. 1 a partially cut-open side view of a hammer drill,

Fig. 2 in a cutout manner a longitudinal section of the hammer drill of Fig. 1 in the region of its mode changeover device,

Fig. 3 a side view of an operating slide in the changeover device of Fig. 2,

Fig. 4 a sheet-metal blank of the operating slide of Fig. 3,

Fig. 5 in a cutout manner a plan view of the machine housing of the hammer drill in the direction of arrow V in Fig. 2 with the cover removed.

Description of the embodiments

The hammer drill, which is illustrated in Fig. 1 in side view and in Fig. 2 in a cutout manner in longitudinal section as an embodiment of a general hand-guided electric tool machine, comprises a housing 10 with handle 11 and a tool holder 12 for receiving a rotary and/or impact tool, which toolholder projects from the end of the housing 10 remote from the handle 11. Driving of the tool is effected by means of an electric motor (not shown here), which is accommodated in the housing 10 and the output shaft 13 (Fig. 2) of which via a first gear train sets the toolholder 12 in rotation and via a second gear train generates a hammering impact motion in an axial direction at the tool held in a non-rotatable but, to a limited extent, axially displaceable manner in the toolholder 12. The output shaft 13 for said purpose carries at its shaft end an output pinion 14 which introduces the rotation of the output shaft 13 via a first driving gear wheel 15 into the first gear train and via a second driving gear wheel 16 into the second gear train, in which the rotation of the driving gear wheel 16 is converted into a hammering impact motion of the tool.

In particular, the first gear train comprises a bevel gear 17, which with the driving wheel 15 is seated in a non-rotatable manner on a shaft stub 18 supported in the housing 10 and meshes with a bevel gearing 19 at the front end of a driver sleeve 20 supported at right angles to the output shaft 13 in the housing

10. The driver sleeve 20 is non-rotatably connected directly or via an overload clutch to a spindle sleeve 21, on the front end of which the toolholder 12 is held in a non-rotatable manner. The rotation of the output shaft 13 is transmitted via the driving gear wheel 15, the bevel gear 17 and the bevel gearing 19 to the driver sleeve 20, which drives the spindle sleeve 21 so that the tool accommodated non-rotatably in the toolholder 12 rotates.

The second gear train is formed by an impact mechanism 22 comprising a piston 23, which lies in an axially displaceable manner in the spindle sleeve 21, and an eccentric drive or crank mechanism 24 which sets the piston 23 in axial motion, the piston 23 at the end of its axial forward motion hitting a striker (not shown in detail), which is supported displaceably in the spindle sleeve 21 and displaces a header 25 with the latter's piston-remote end face onto an end face of a tool shank, the impact-like hitting of the striker against the header 25 being transmitted as a kind of hammering motion to the tool. The crank mechanism 24 comprises a crank arm 26 and a connecting rod 27, which is coupled to the crank arm 26 and hinge-connected to the piston 23. The crank arm 26 is seated non-rotatably on a countershaft 28, which is supported in the housing 10 and on which is also seated the driving gear wheel 16 of the second gear train which meshes with the output pinion 14 of the output shaft 13. The hinge axes of the connecting rod 27 on the piston 23 and on the crank arm 26 are aligned parallel to one another and parallel to the longitudinal axis 281 of the countershaft 28. The joint between crank arm 26 and connecting rod 27 is realized by a bore 29 in the connecting rod 27, into which bore a pivot pin 30 disposed eccentrically relative to the longitudinal axis 281 on the crank arm 26 projects. The piston-side joint of the connecting rod 27 is realized by a transverse bore 31 in the piston 23 and by a transverse pin 32, which is inserted through the connecting rod 27 and projects with its two protruding ends into the transverse bore 31. The connecting rod 27 in said case dips with its piston-side end into a diametral transverse groove 54

introduced from the end face of the piston 23 and extending at right angles to the transverse bore 31.

In the second gear train designed as an impact mechanism 22 a mode changeover device 33 is provided, by means of which the hammer drill may be changed over from "combined drilling and hammering" mode with both a rotating and also an impact action of the tool to "drilling" mode with an exclusively rotating tool and vice versa. To said end, the changeover device 33 comprises a clutch 34 and a manually operable changeover element 35 for engaging and disengaging the clutch 34. The two clutch parts of the clutch 34 are formed, on the one hand, by the driving gear wheel 16, which is seated on the countershaft 28 and to said end is seated in a freely rotating and axially displaceable manner on the countershaft 28 and provided with an internal gearing 36, and by an external gearing 37 provided on an annular portion of the countershaft 28. By displacing the driving gear wheel 16 in the direction of the longitudinal axis 281, said driving gear wheel may be inserted by its internal gearing 36 into the external gearing 37 of the countershaft 28 so that the driving gear wheel 16 is connected non-rotatably to the countershaft 28 and the output shaft 13 via output pinion 14 and driving gear wheel 16 sets the crank arm 26 of the crank mechanism 24 in rotation, said crank arm in turn driving the connecting rod 27 into a reciprocating swivelling motion which the connecting rod 27 converts into an axial motion of the piston 23 guided displaceably in the spindle sleeve 21. When the driving gear wheel 16 is displaced on the countershaft 28 to such an extent that internal gearing 36 and external gearing 37 disengage, the driving gear wheel 16 then rotates freely on the countershaft 28 and the crank mechanism 24 is stopped. The impact mechanism 22 is therefore disconnected.

For displacing the driving gear wheel 16, the changeover element 35 has an operating slide 38, which engages with an operating fork 39 over the opposite-lying end faces of the driving gear wheel 16 with a slight play which allows rotation of the driving gear wheel 16 in the operating fork 39. The

operating slide 38 is held displaceably parallel to the longitudinal axis 281 of the countershaft 28 in the housing 10 and carries, for its axial displacement, at its fork-remote end a control lug 40 cooperating with a changeover knob 41, which is rotatable about an axis of rotation 411. As is evident from Fig. 2, the die-cast housing 10 is open at the top and closed off by means of a cover 42 preferably made of plastic material. The, in cross section, substantially T-shaped changeover knob 41 is accommodated in a stepped recess 43 disposed in the cover 42, the cylindrical middle part 411 of said knob being accommodated rotatably in the smaller-diameter recess portion 431 of the recess 43. The axis of rotation 411 of the changeover knob 41 is aligned parallel to the longitudinal axis 281 of the countershaft 28. Formed on the underside of the middle part 411 of the changeover knob 41 is a ramp-like control cam 44, which extends in direction of rotation of the changeover knob 41 and against which the control lug 40 of the operating slide 38 rests under spring action. In the position of the mode changeover device 33 shown in Fig. 2, the clutch 34 is engaged and the hammer drill is operating in combined "drilling and hammering" mode. To disconnect the impact mechanism 22, the changeover knob 41 has to be rotated through 180°. During said process, the control lug 40 of the operating slide 38 runs up onto the control cam 44 and the operating slide 38 is displaced counter to the spring force in a downward direction in Fig. 2, the driving gear wheel 16 on the countershaft 28 being displaced by the operating fork 39 in a downward direction in Fig. 2. The internal gearing 36 of the driving gear wheel 16 is therefore withdrawn from the external gearing 37 of the countershaft 28 and held by the operating slide 38 in said disengaged position. As is illustrated in Fig. 3, the control lug 40 carries at its free end an embossed cavity 45 and the control cam 44 is provided with two axially downward projecting detent cams (not shown here). In each of the two end rotary positions of the changeover knob 41, one of said two cams latches into the cavity 45.

The operating slide 38 with operating fork 39 and control lug 40 is manufactured as a sheet-metal punching, the sheet-metal blank of which is shown in Fig. 4. After the sheet-metal blank has been punched out, the fork tines 391 and 392 and the control lug 40 are bent through 90° from the flat sheet-metal blank along the fold lines shown by dashed lines in Fig. 4, thereby producing the operating slide 38 shown in profile in Fig. 3. For applying the spring force at the operating slide 38, the latter additionally comprises two transversely projecting slide arms 46, 47 which are used, on the one hand, as an abutment for compression springs 48, 49 (Fig. 5) disposed in the housing 10 and, on the other hand, to guide the operating slide 38 in the housing 10.

In Fig. 5 the empty die-cast housing 10 is shown in a cutout manner with the plastic cover 42 removed. The two compression springs 48, 49 are accommodated and prestressed in guide chambers 50, 51 formed in the housing 10. Provided in each guide chamber 51 at the sides directed towards one another is a guide slot 52 or 53, which extends over the displacement path of the two slide arms 46, 47 of the operating slide 38. The slide arms 46, 47 engage through said guide slots 52, 53, and the prestressed compression springs 48, 49 via the slide arms 46, 47 apply the control lug 40 against the ramp-like control cam 44 at the underside of the changeover knob 41.

CLAIMS

1. Electric tool machine for rotary and/or impact tools, in particular a hammer drill or impact drilling machine, having a toolholder (12) for receiving a tool, having at least one gear train driven by an output shaft (13) of an electric motor for operating the tool in at least two different modes and having a changeover device (33) for switching between the modes which comprises a clutch (34), which is disposed in the at least one gear train and has at least two clutch parts disposed on a shaft (28), and a manually operable changeover element (35) for engagement and disengagement of the clutch (34) by axially displacing one of the clutch parts on the shaft (28), characterized in that the changeover element (35) comprises a rotatable changeover knob (41), the axis of rotation (411) of which lies substantially parallel to a longitudinal axis (281) of the shaft (28) and which may be used to operate an operating slide (38), which is longitudinally displaceable substantially parallel to the axis of rotation (411) of the changeover knob (41) and engages in operating direction positively behind the displaceable clutch part (16).

2. Electric tool machine according to claim 1, characterized in that the displaceable clutch part is a driving wheel (16) which is situated in constant engagement with the output shaft (13) and seated in a freely rotating and axially displaceable manner on the shaft (28).

3. Electric tool machine according to claim 2, characterized in that the driving wheel (16) on its inner annular surface carries an internal gearing (36), which may be brought into engagement with a corresponding external gearing (37) on the other clutch part, which is preferably firmly connected to the shaft (28).

4. Electric tool machine according to one of claims 1 - 3, characterized in that the shaft takes the form of a countershaft (28).

5. Electric tool machine according to claim 4, characterized in that the longitudinal axis (281) of the countershaft (28) lies substantially at right angles to an axis of the toolholder (12).

6. Electric tool machine according to one of claims 1 - 5, characterized in that the changeover knob (41) has at its underside a ramp-like control cam (44) extending in its direction of rotation and that the operating slide (38) has a control lug (40) which is supported under spring action against the control cam (44).

7. Electric tool machine according to claim 6, characterized in that the operating slide (38) has two slide arms (46, 47) projecting transversely in diametral directions and having, supported against their underside remote from the control lug (40), compression springs (48, 49) received in each case by a stationary abutment.

8. Electric tool machine according to claim 7, characterized in that the compression springs (48, 49) are situated each in one of two guide chambers (50, 51) formed in the machine housing (10) and that the guide chambers (50, 51) at sides directed towards one another have longitudinal slots (52, 53), which extend over the displacement path of the slide arms (46, 47) and in each of which the end of one of the slide arms (46, 47) is guided.

9. Electric tool machine according to one of claims 6 - 8, characterized in that the operating slide (38) at its end remote from the control lug (40) carries an operating fork (39) having fork tines (391, 392), which project at right angles and engage with play over both end faces of the driving wheel (16).

10. Electric tool machine according to claim 9, characterized in that the operating slide (38) is manufactured as a sheet-metal punching and the control lug (40) and the operating fork (39) are bent out from the sheet-metal blank.

11. Electric tool machine according to one of claims 1 - 10, characterized in that the clutch (34) is disposed in an impact mechanism (22), which forms one of two gear trains and generates an axial hammering motion upon a tool, which is accommodated in a non-rotatable and to an axially limited extent longitudinally displaceable manner in the toolholder (12), while the tool is being rotated via the second gear train.

12. Electric tool machine according to claim 11, characterized in that the impact mechanism (22) comprises a piston (23), which is supported in an axially displaceable manner in a sleeve (21) and of which the axially accelerated driving motion is transmitted via a header (25) to the tool clamped in the toolholder (12), and that an eccentric drive or crank mechanism (24) is disposed between the piston (23) and the countershaft (28).

13. Electric tool machine according to claim 12, characterized in that a radially projecting crank arm (26) is non-rotatably connected to the countershaft (28) and that a connecting rod (27) is coupled to the piston (23) and to the crank arm (26) by hinge axes which are parallel to the countershaft (28).

14. Electric tool machine according to claim 12 or 13, characterized in that the sleeve (21) receiving the piston (23) in an axially displaceable manner is drivable by the output shaft (13) via a bevel gearing (17 - 19) and at its end carries the toolholder (12) in a non-rotatable manner.

15. An electric machine tool substantially as herein described with reference to the accompanying drawings.

The Patent Office

13.

Application No: GB 9807916.3 **Examiner:** Hal Young
Claims searched: 1-15 **Date of search:** 11 June 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): B4C

Int Cl (Ed.6): B23B(45/00, 02, 16) ; B25D(11/00 ; 16/00)

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2121717 A	(BLACK&DECKER), see figs 1-4, lines 86-104 of page 2 and 39-89 of page 3.	1,2,5,6, 11-13
A	EP 0608083 A1	(BLACK&DECKER)	
A	US 4418766	(BLACK&DECKER)	

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.
& Member of the same patent family
A Document indicating technological background and/or state of the art.
P Document published on or after the declared priority date but before the filing date of this invention.
E Patent document published on or after, but with priority date earlier than, the filing date of this application.